

Cardiac Auscultation

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Today

- Systolic murmurs
- Diastolic murmurs
- Unknowns



Murmurs

- Murmurs are prolonged in time while sounds are instantaneous
- Result from turbulence
 - Turbulence occurs when laminar flow breaks down
 - excessive acceleration
 - Loss of viscosity



Blood must accelerate to negotiate small apertures





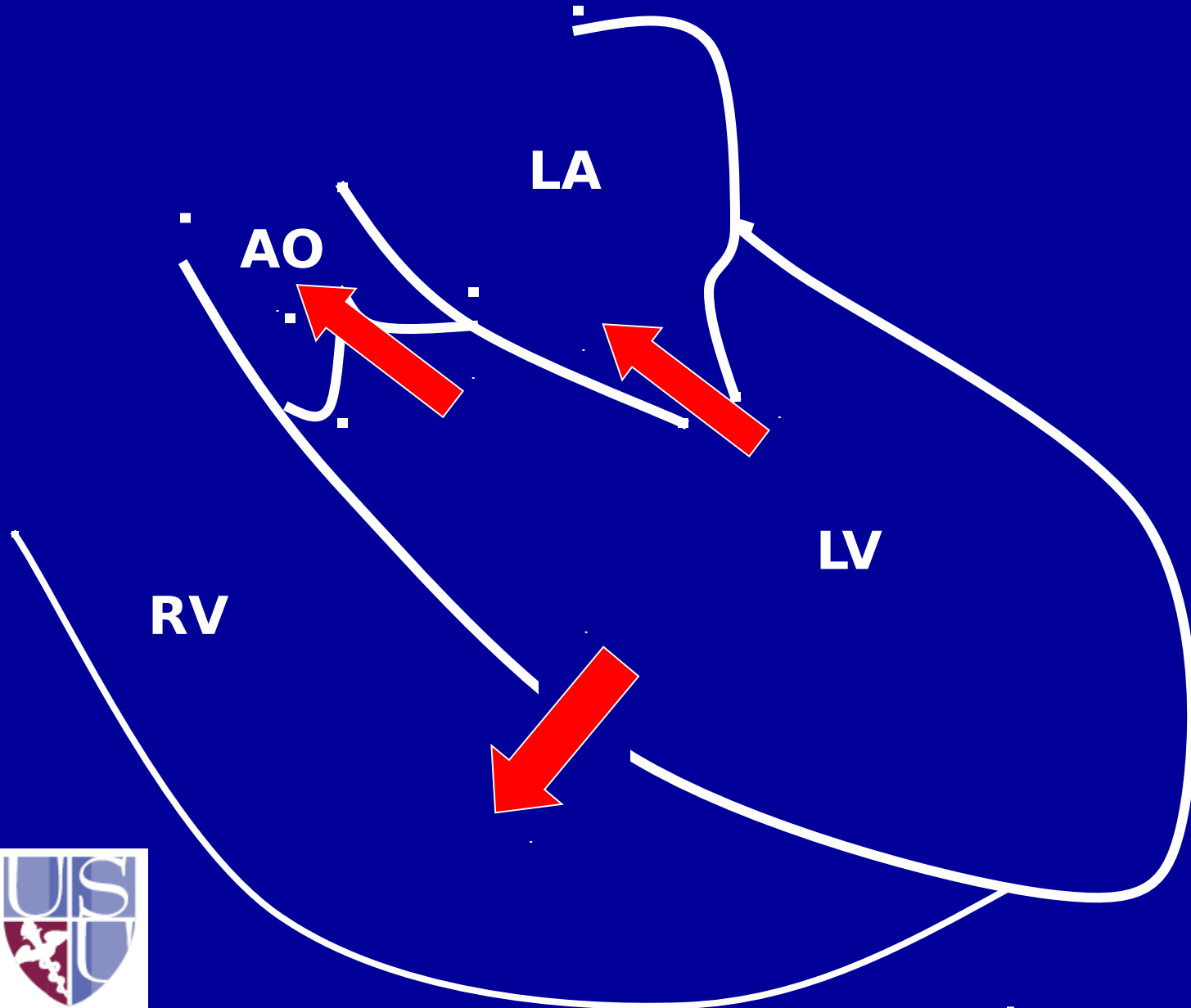
What if you hear something?

- Is it systolic, diastolic, or both?
 - What is the pattern?
- Where is it loudest?
- Does it radiate?
- Are there other associated findings?
 - S2 splitting normal, loud P2, gallop sound?

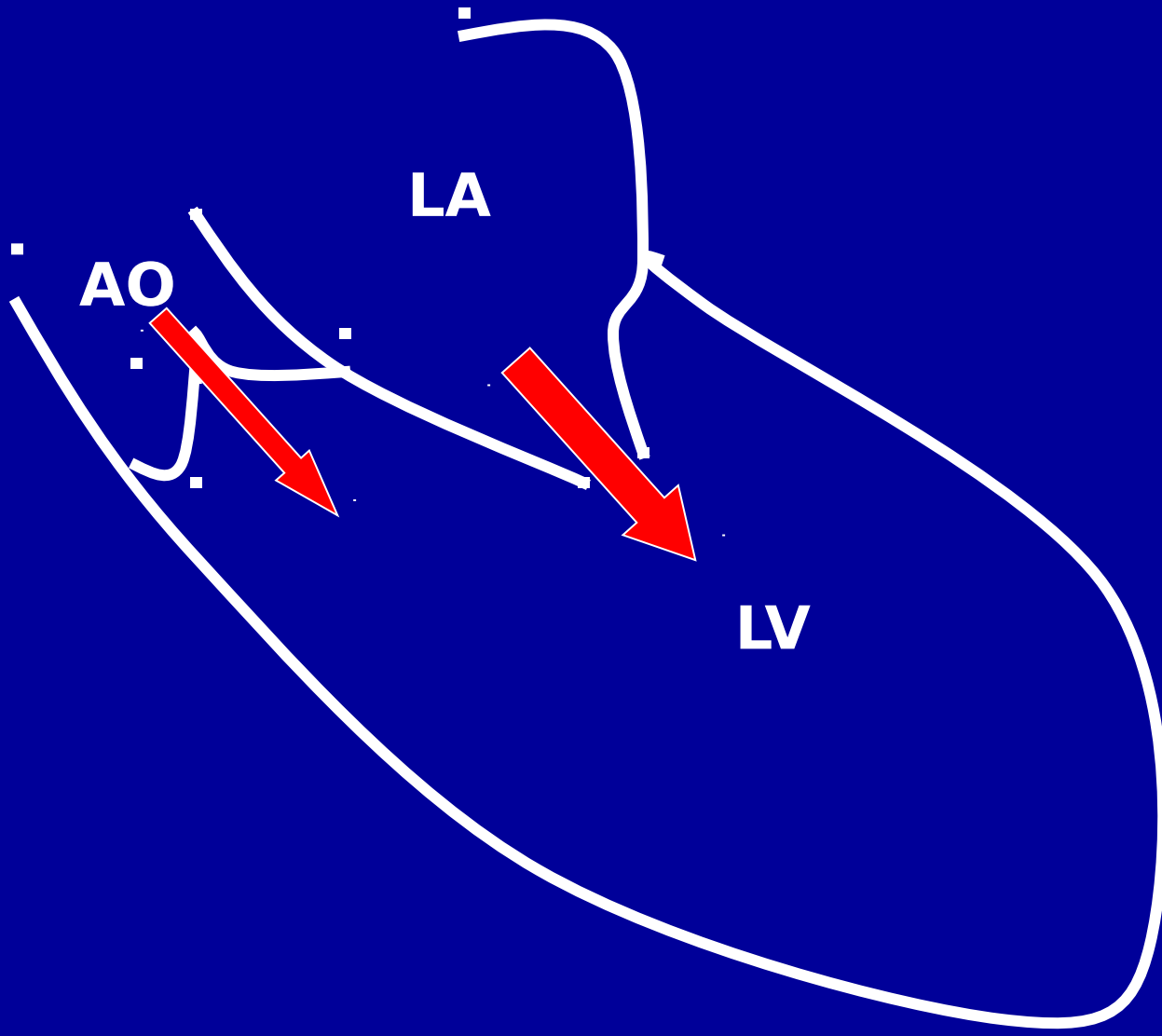
• Maneuvers



Systole



Diastole



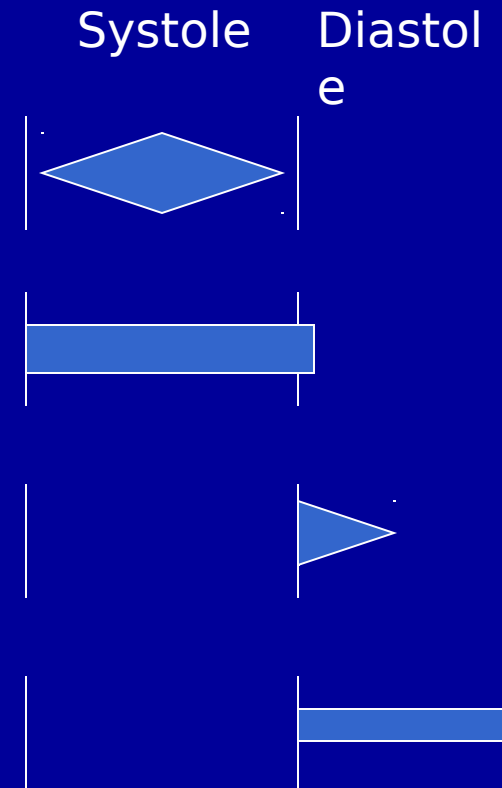
Grading Murmurs

- Scale one to six
- I/VI murmur is less than S1/S2
- II/VI murmur is equal to S1/S2
- III/VI murmur is greater than S1/S2
- IV/VI murmur is associated with a palpable thrill
- V/VI can be heard with the stethoscope partway on chest
- VI/VI audible with naked ear



Murmur Patterns

- Common systolic
 - Crescendo-decrescendo
 - Holosystolic
- Common diastolic
 - Decrescendo
 - Holodiastolic



Radiation of Murmurs

- Murmurs will be heard downstream from source
 - Aortic stenosis radiates to carotids
 - Pulmonic Stenosis to pulmonary artery (LIC)
 - Aortic regurgitation to the LLSB
 - Mitral regurgitation to the axilla





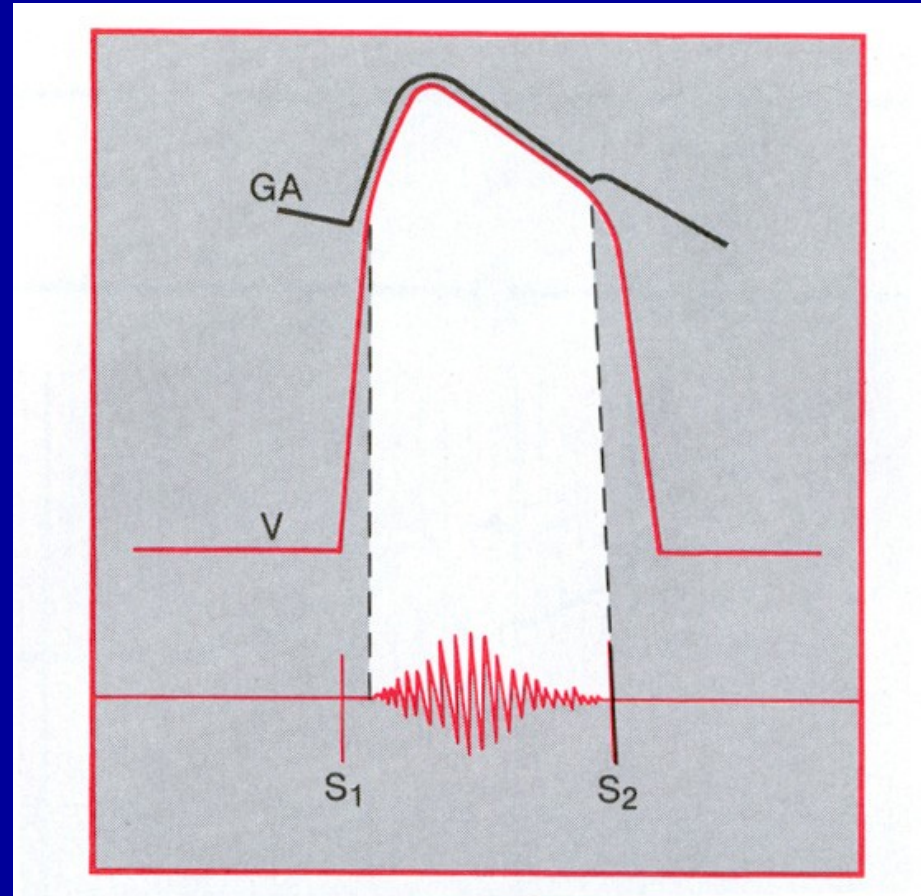
Mid-systolic Ejection Murmurs

- Caused by turbulent flow out of ventricles into great arteries
- Increased ejection rate or decreased viscosity
 - Exercise, fever
 - pregnancy, anemia
- Semi-lunar valve narrowing
 - Aortic Stenosis
 - Pulmonic Stenosis
- Intraventricular obstruction
 - Subaortic or subpulmonic



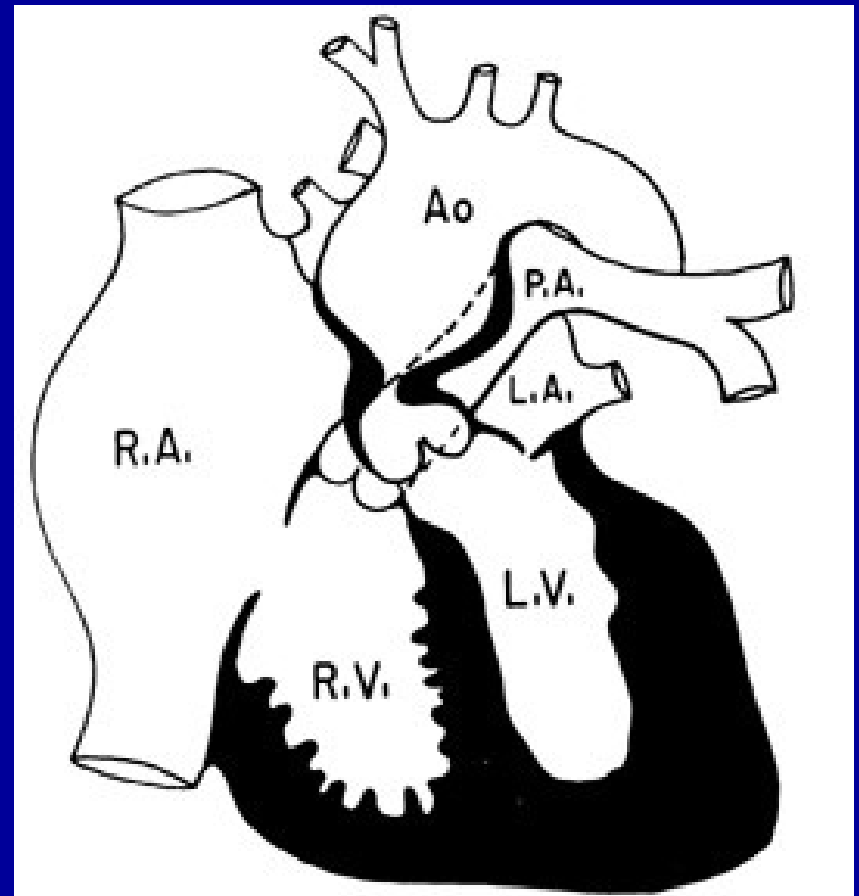
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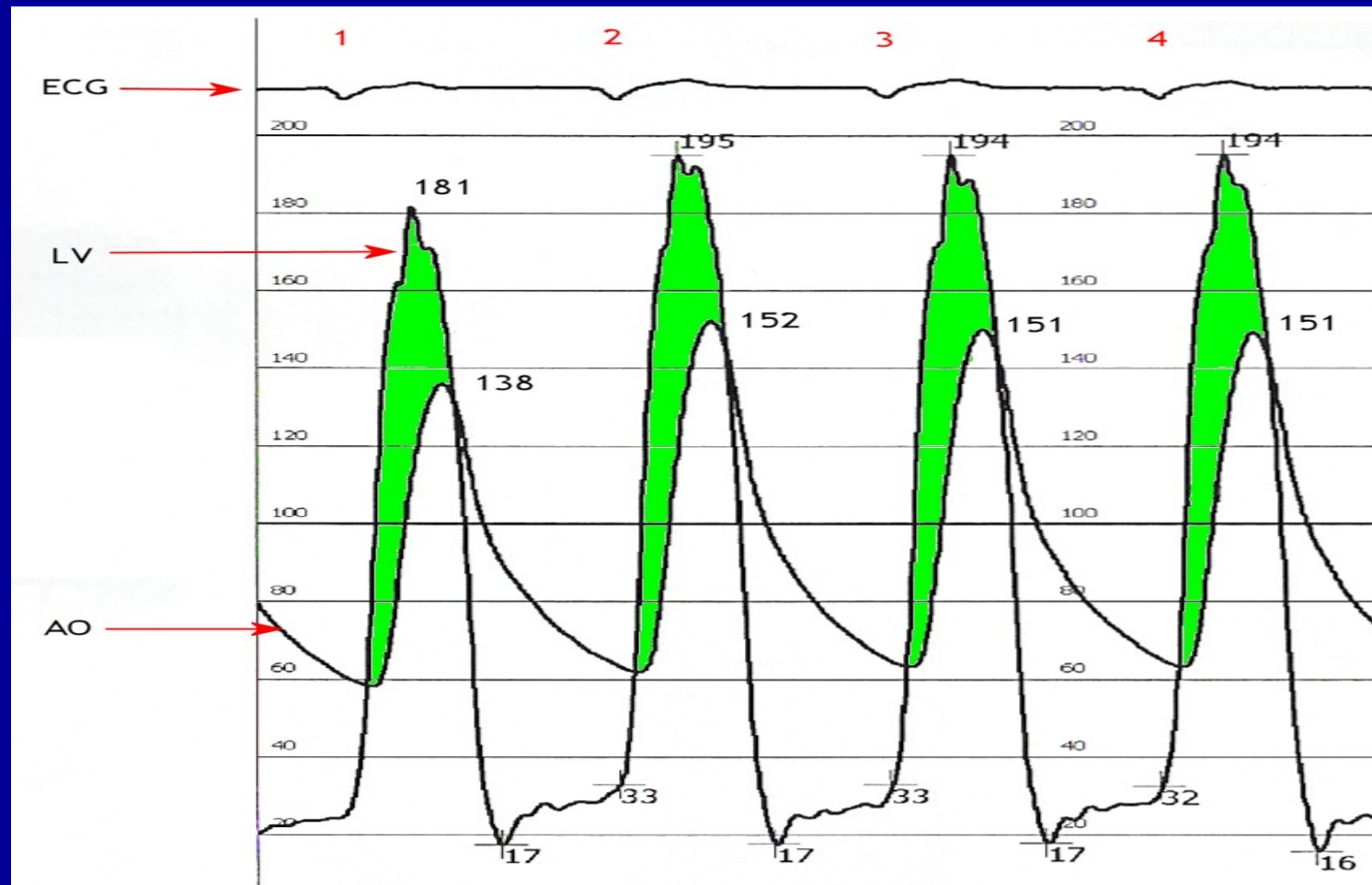
- Crescendo-decrescendo
- High-pitched
- Best heard with diaphragm
- Well-localized



Aortic Stenosis

- Valvular
- Subvalvular
 - Fixed (membrane)
 - Dynamic (HCM; IHSS)
- Supravalvular





Valvular Aortic Stenosis





Aortic Stenosis

- Signs of severity
 - Signs/symptoms of heart failure
 - S4
- Critical AS
 - Delayed, small volume carotid upstrokes
 - “shuddering” or “hesitating” quality
 - “pulsus parvus et tardus”
 - Loss of A2
 - Late peaking murmur



Bicuspid Aortic Valve

- Most common congenital cardiac abnormality
 - 2-4% of population
 - 4x more likely in boys
- No AS present until leaflets become stiff
- 20% have co-existing cardiac abnormality
 - Coarctation of the aorta, PDA, circle of Willis aneurysms, aortic root dilatation



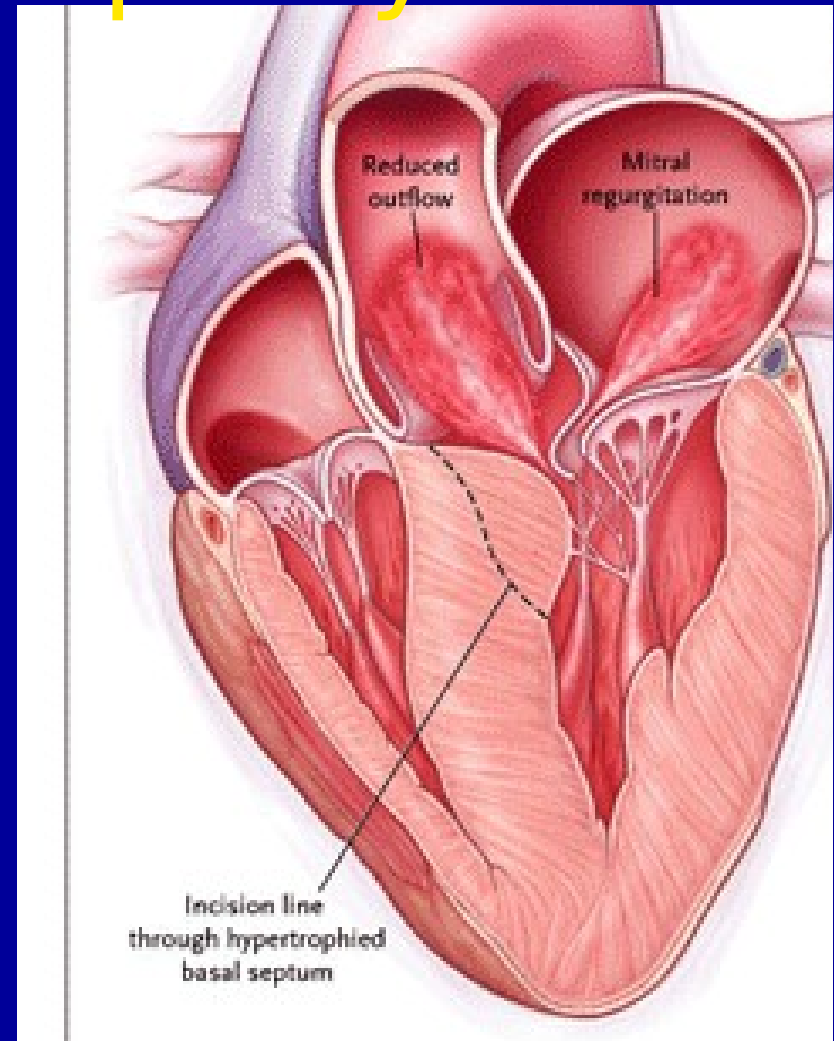
Hypertrophic Cardiomyopathy

- Autosomal dominant disorder of contractile proteins
 - Frequently causes asymmetric thickening of the interventricular septum, obstructing outflow
 - The most common cause of sudden death in American athletes



Hypertrophic Cardiomyopathy

- Bulging of septum into outflow tract occurs as systole progresses
- Causes MSM similar to AS but heard at LLSB; brisk carotid upstrokes; no ejection sound; murmur increases with standing or Valsalva





Pulmonic Stenosis

- Usually congenital, may be associated with other abnormalities
- Causes a mid-systolic ejection murmur similar to AS but does NOT radiate to carotids
 - Radiates to left infraclavicular area
 - Murmur intensity and ejection sound vary with respiration
 - Widened S2 split
 - Balloon valvuloplasty when gradient exceeds 30-50 mm Hg



Innocent Systolic Murmur

- Caused by high flow in outflow tracts
- Crescendo-decrescendo ejection murmur
 - Ubiquitous in pregnancy; common in children, anemia, fever, high output states
- Brief, early peaking
- Localized to either pulmonic or aortic areas
- NORMAL S2 splitting
- No other abnormalities present

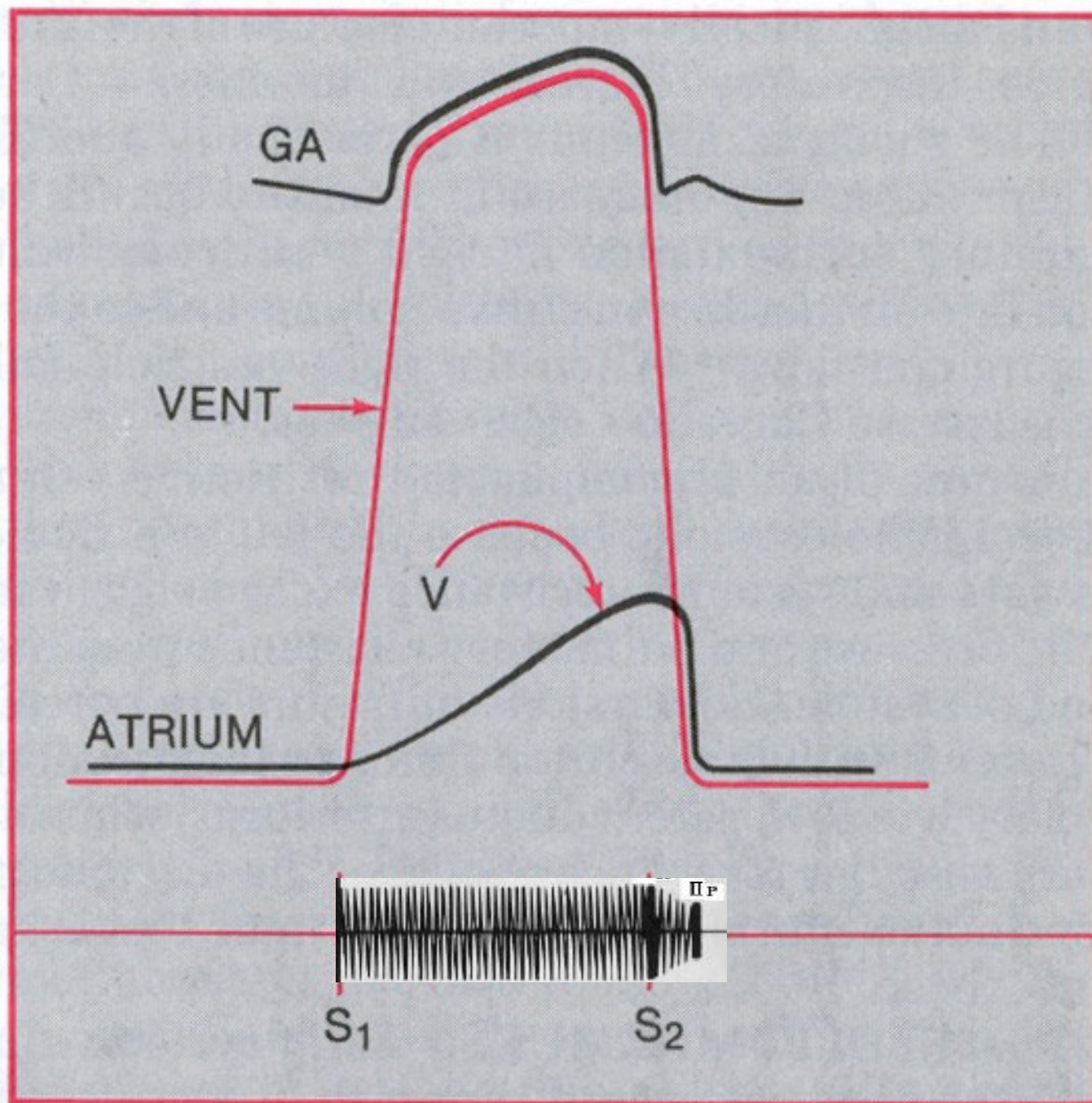




Holosystolic Murmurs

- AKA “Pansystolic Murmurs”
- Begin with S1 and end after S2
- Caused by flow from high pressure area to much lower pressure area
 - Ventricle to atrium
 - Left ventricle to right ventricle
- Harsh, “blowing,” well-heard with diaphragm







Holosystolic Murmurs

- Atrioventricular valve leakage
 - Mitral Regurgitation
 - Tricuspid Regurgitation
- Interventricular shunt
 - Ventricular septal defect

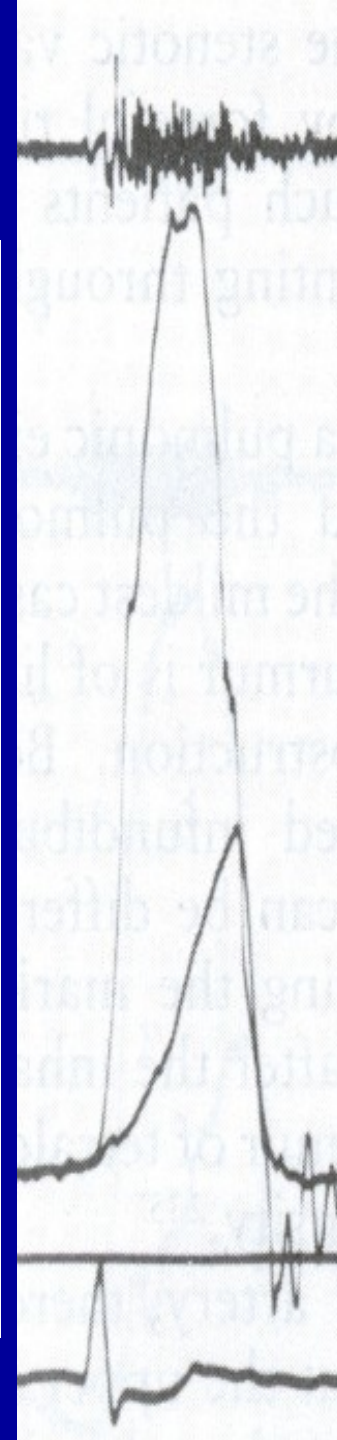
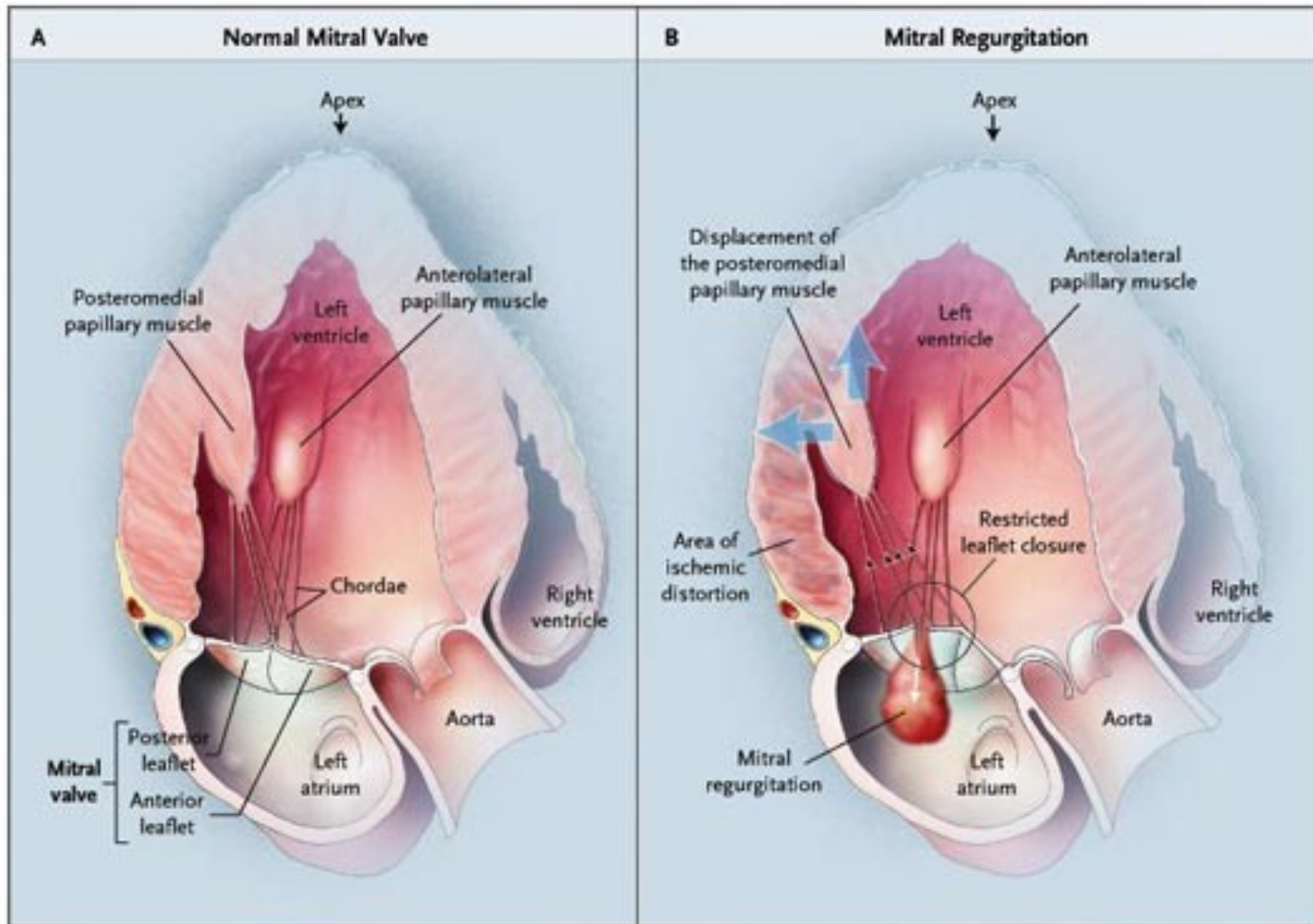


Chronic Mitral Regurgitation

- Progressive Mitral Valve Prolapse most common cause
- LV dilatation, rheumatic, congenital, endocarditis, infarction
- Results in chronic volume overload of left ventricle
 - Acute MR may have very brief murmur due to rapid equilibration of pressures



Mitral Regurgitation after MI

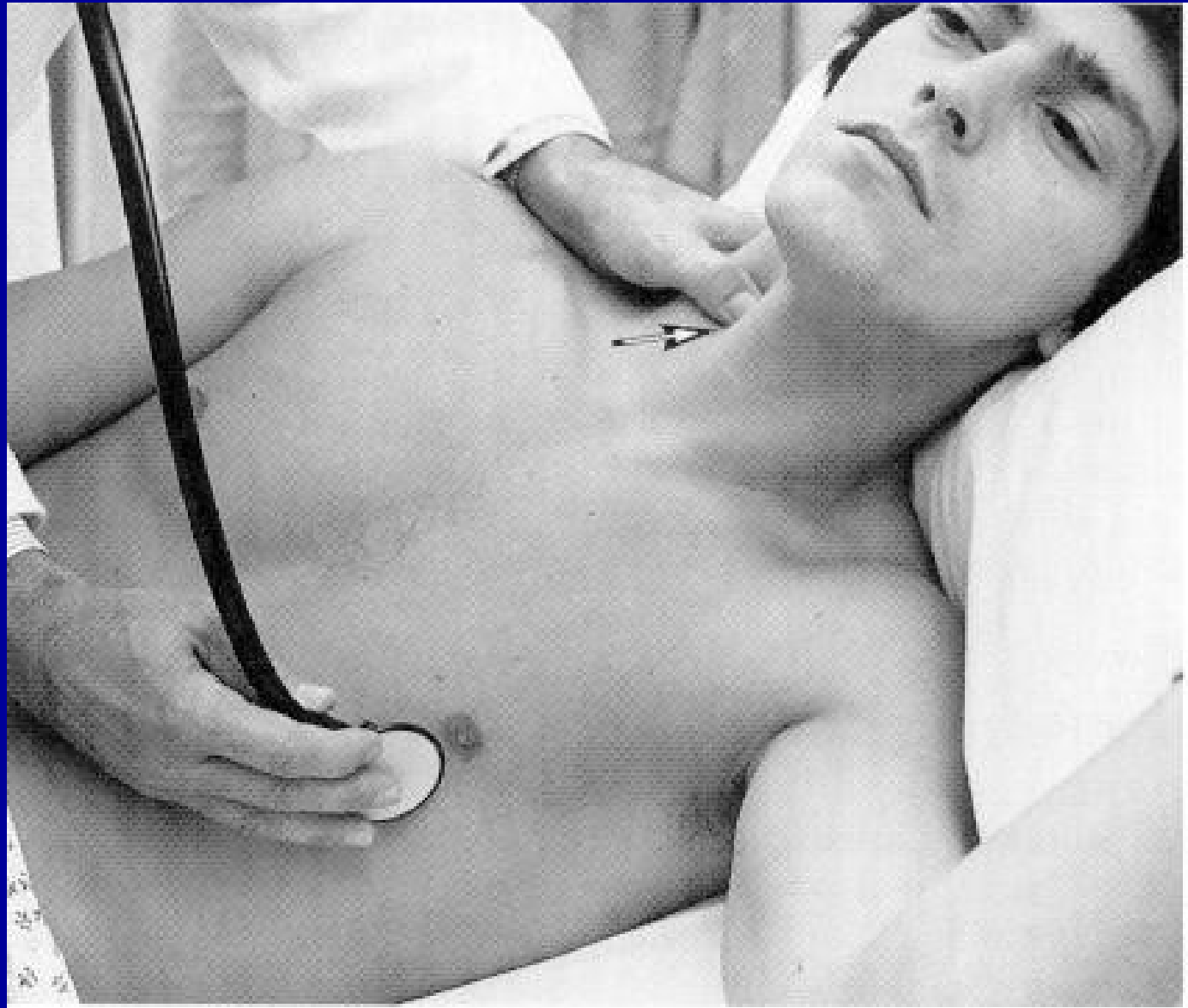


MR

- Radiates to axilla or back in most cases
- May radiate to the base if posterior leaflet prolapse
- Well heard with diaphragm but listen with bell also for S3 or diastolic “flow” rumble
 - Due to high volume flowing back from LA
- No change in intensity after a PVC but increases with isometric exercise and squatting (increases afterload)



Left lateral decubitus



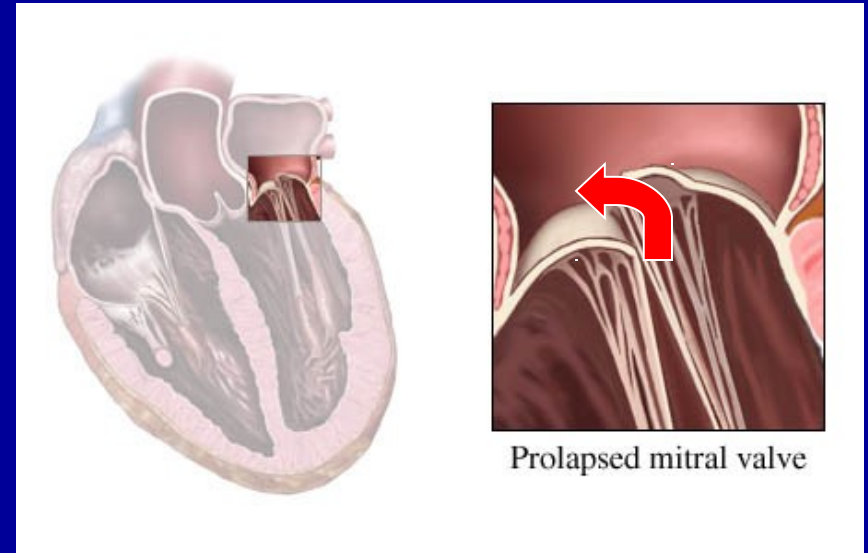
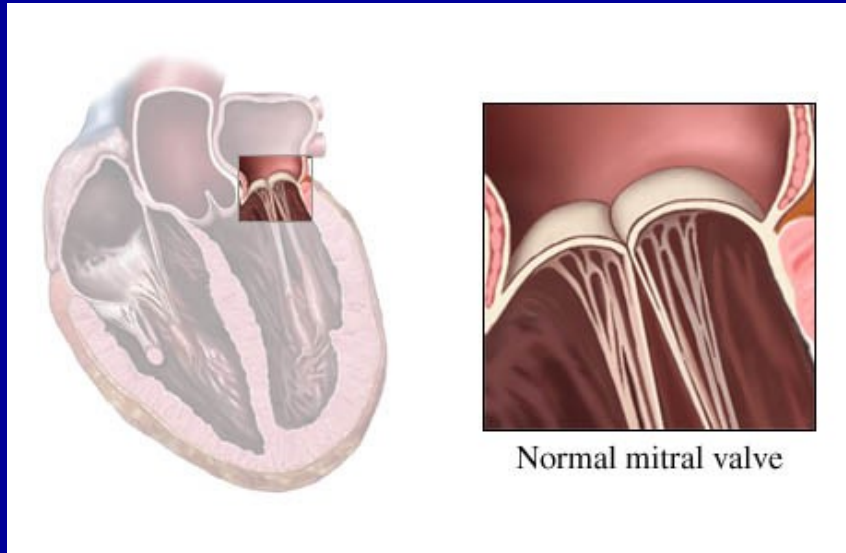


Signs of severity in MR

- Loud murmur (III/VI)
 - Sometimes misleading, like in acute MR
- S3 and/or diastolic rumble
- Enlarged LV impulse
 - Larger than a quarter
- Atrial fibrillation
- Signs of congestive heart failure



Mitral Valve Prolapse



Movement of mitral leaflet into LA during systole can cause mid systolic “Click” sound

If severe enough, will cause mitral regurgitation as well. MR may NOT be holosystolic and will follow click. Changes timing with posture

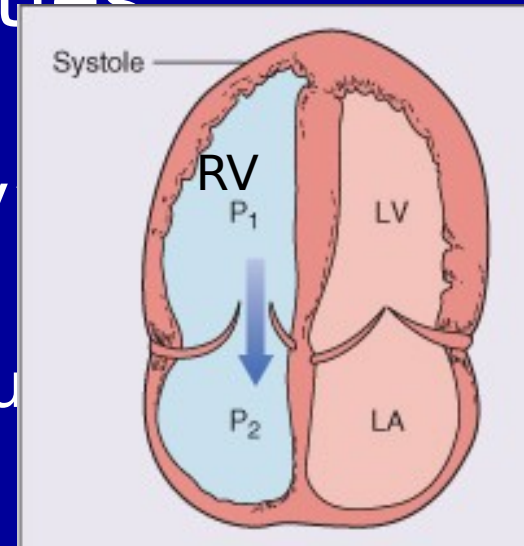




Tricuspid Regurgitation

Etiologies

- Functional– overload
 - Pulmonary hypertension
 - RV dilatation from infarction or myopathy
- Structural– leaflet abnormalities
 - Infectious endocarditis
 - Congenital (“Ebsteins anomaly”)
 - Acquired
 - Carcinoid, plantain diet, ergot drugs



TR Auscultatory Features

- Holosystolic murmur at lower LSB and 4th-5th interspace
- Possible S3 with flow rumble
- Intensity VARIES WITH RESPIRATION



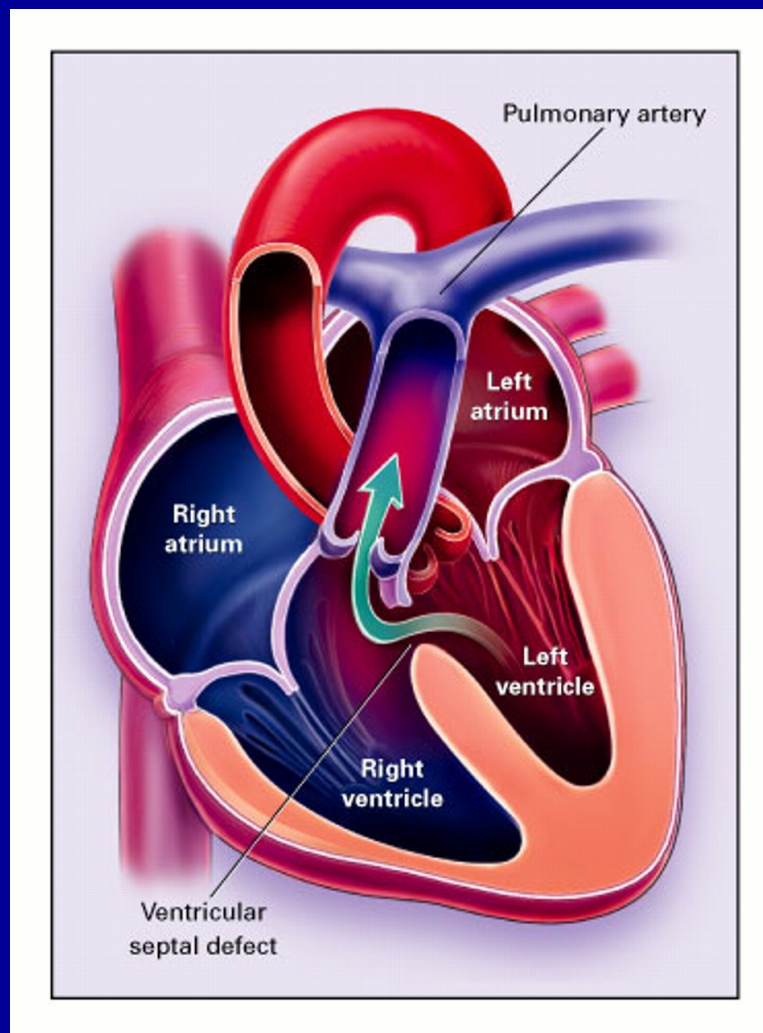
TR: Markers of Severity

- Large pulsations in the neck veins
- Pulsatile, enlarged liver
- Widespread edema
 - Anasarca
 - “Michelin tire man”
- RV S3
 - Increases with respiration





Ventricular Septal Defect with Resultant Left-to-Right Shunting



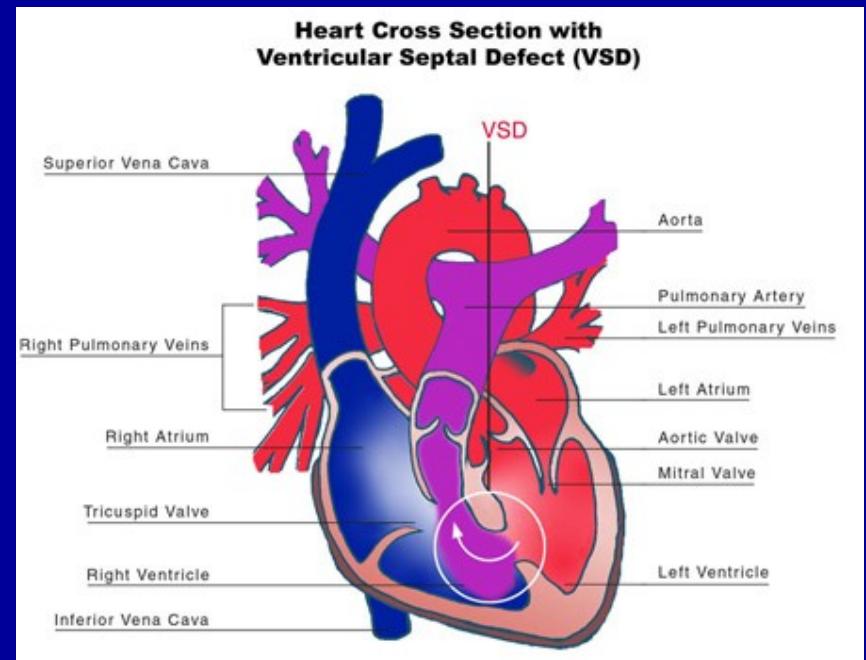
Brickner, M. E. et al. N Engl J Med 2000;342:256-263



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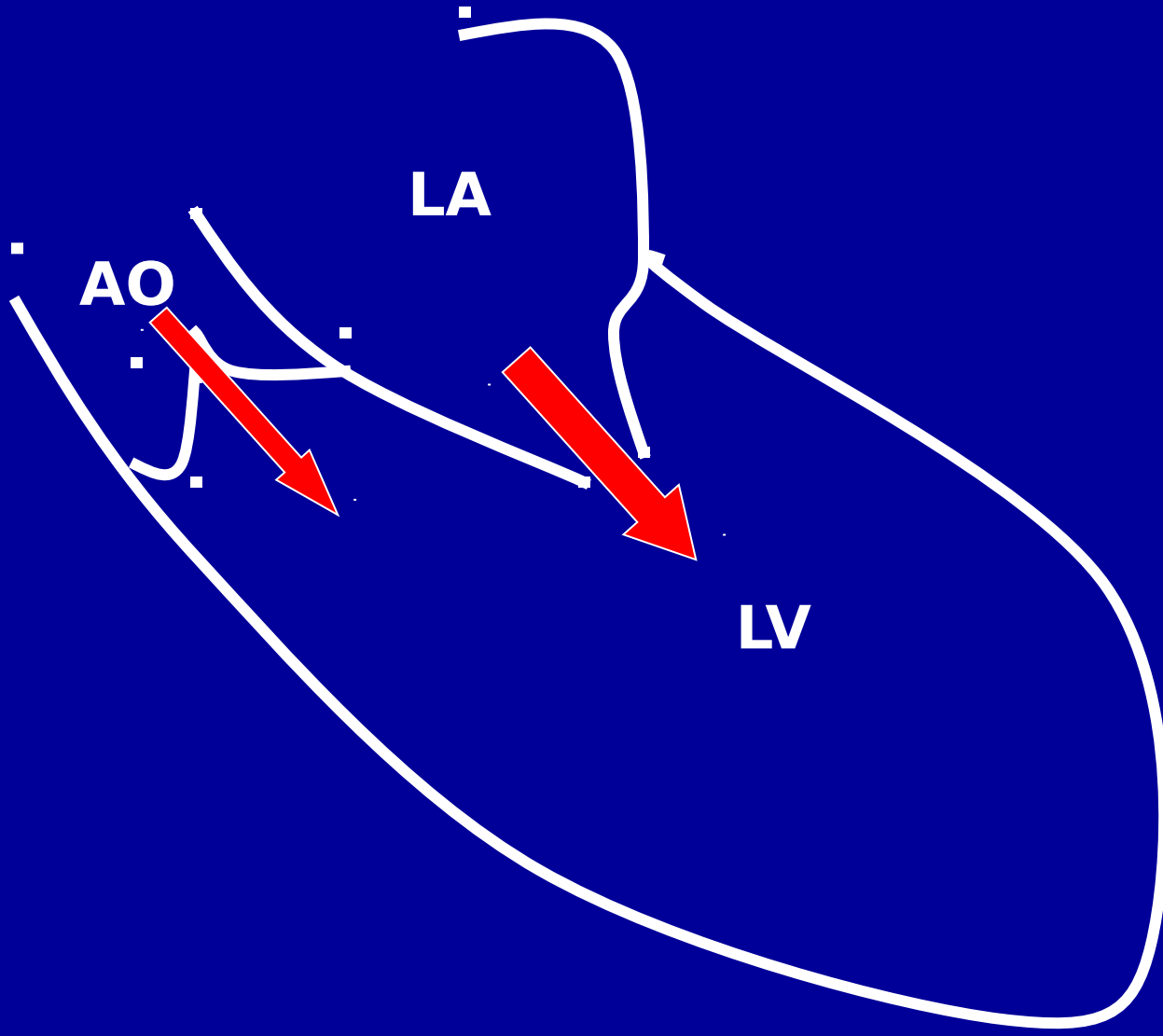
Ventricular Septal Defect

- Usually congenital;
90% close by age 10
- acquired due to MI
or trauma
- HSM due to shunt
from left ventricle-
to-right ventricle
- Murmur typically at
lower left sternal
border
 - Thrill may be present





Diastole



Mitral Stenosis

- “always” rheumatic in origin
- Turbulent, high velocity flow occurs during diastole
- Always look for MS in patient with new Atrial fibrillation

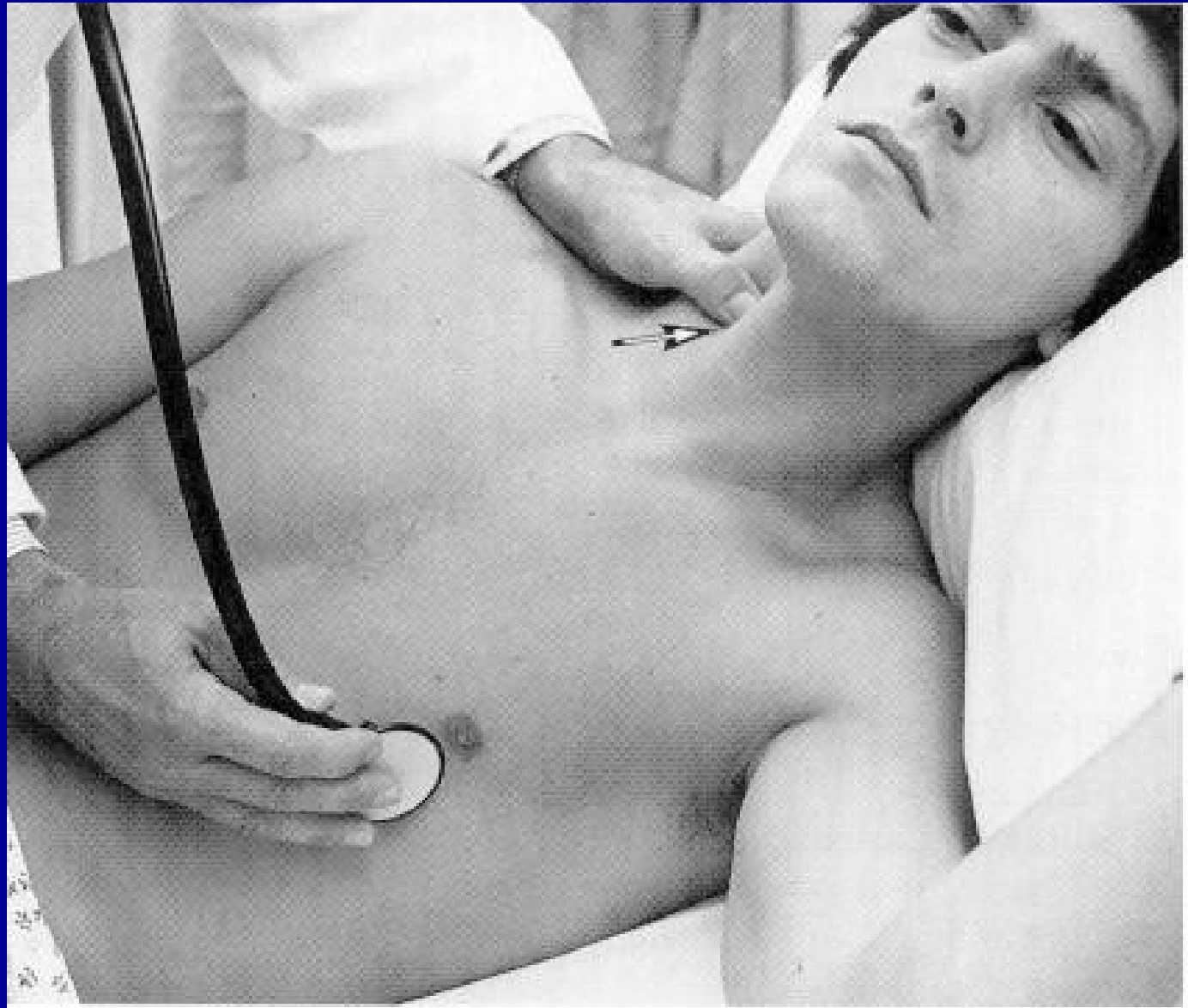


Mitral Stenosis

- Opening snap
- Loud S1, loud P2 if pulmonary hypertension present
- Rumbling diastolic murmur
 - heard at apex with stethoscope bell, patient in L lateral decubitus
 - Palpate carotid to identify diastole
 - Presystolic accentuation unless AFib present
 - Exercise, maneuvers to increase flow make murmur louder



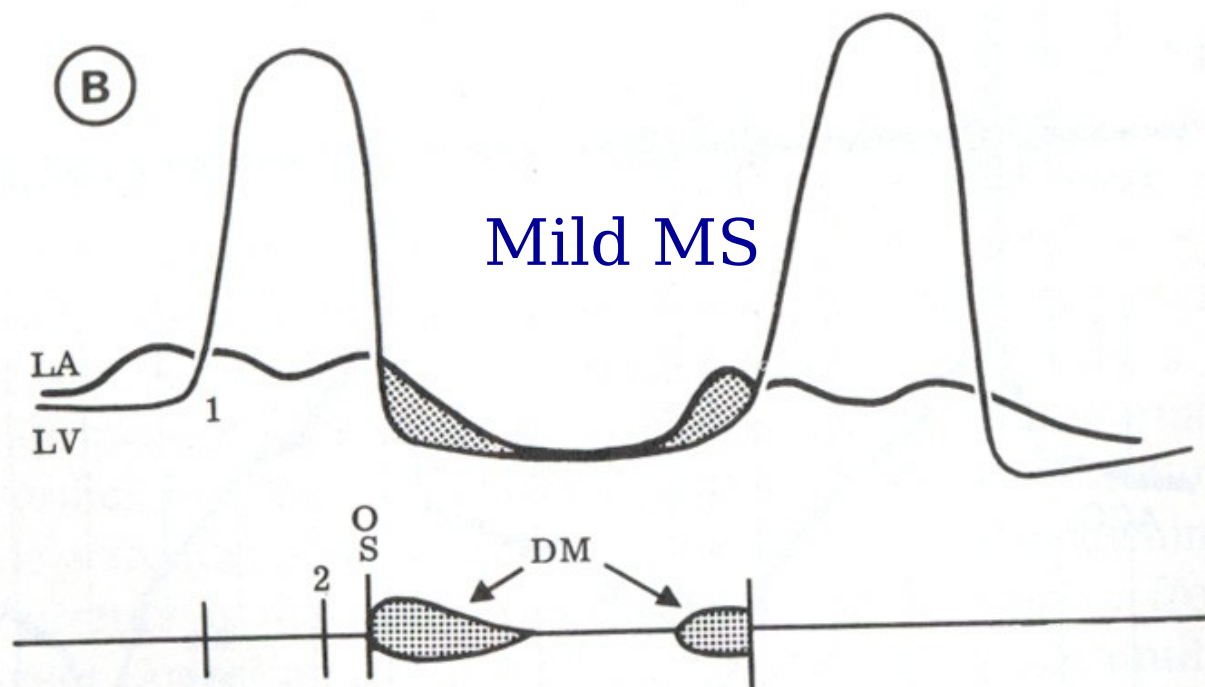
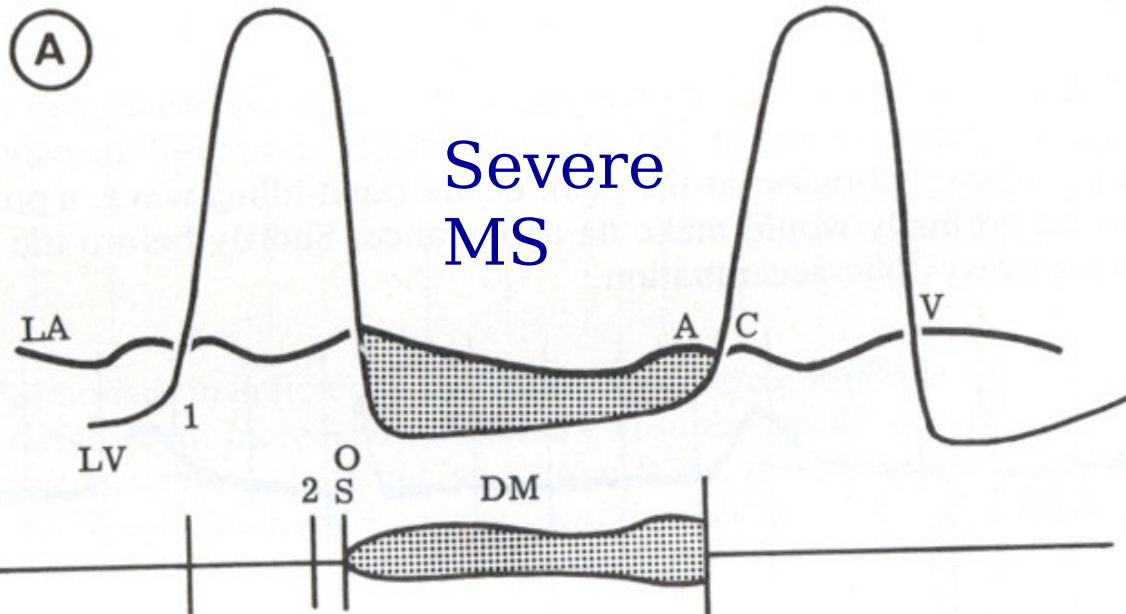
Left lateral decubitus



MS Murmur

Severe MS
associated
with pan-
diastolic
rumble,
short S2-OS
interval.

Mild MS (B)
associated
with
decreased





Markers of Severity

- Long diastolic rumble
- Short A2-OS interval
- Loud P2 and RV lift suggesting pulmonary hypertension
- Atrial fibrillation
- Congestive heart failure



Aortic Regurgitation

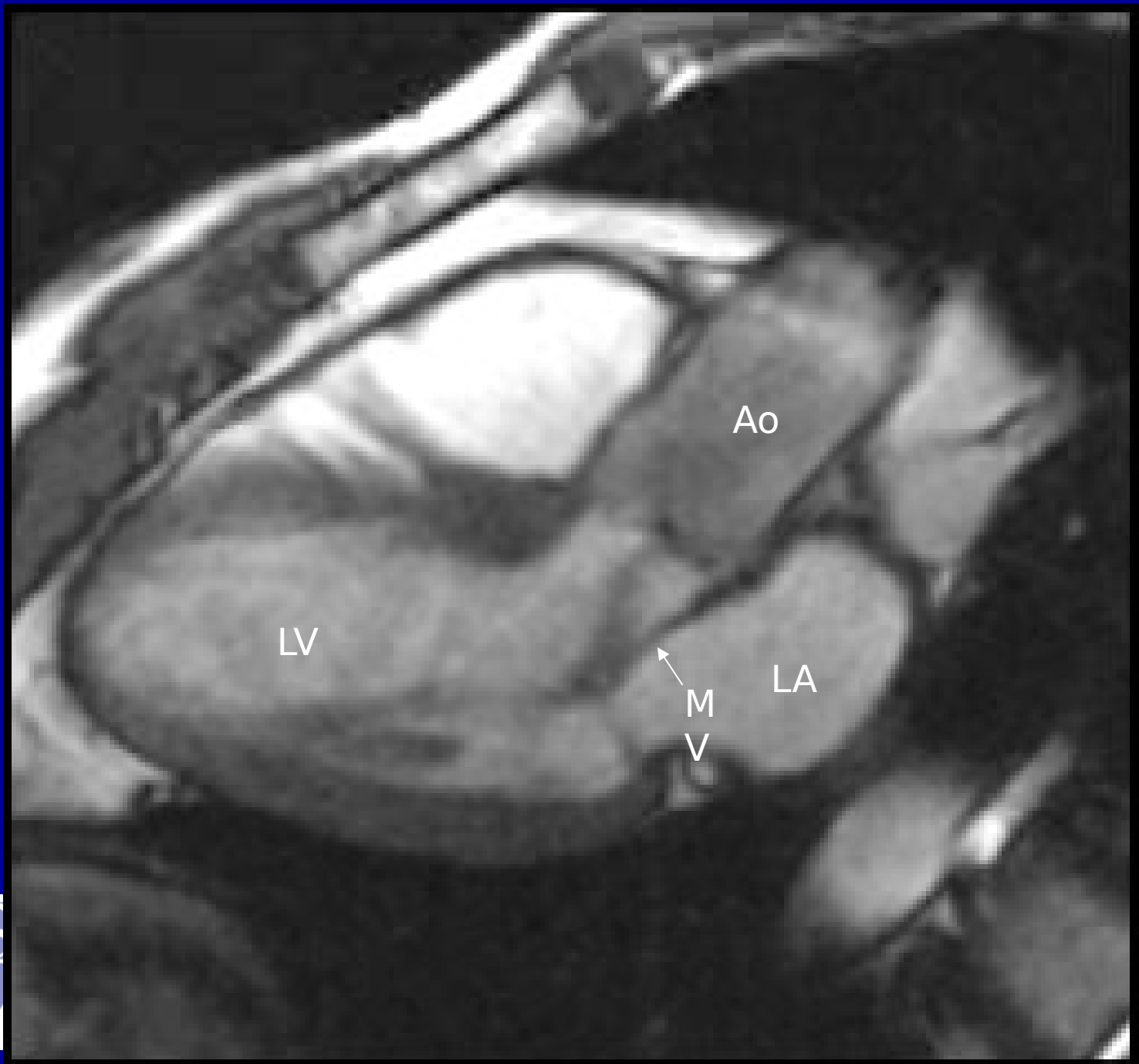
- Loss of cardiac output backwards from aorta into LV
- congenital, endocarditis, age, aortic disease, collagen vascular, syphilis
- Early diastolic, decrescendo murmur best heard at LLSB with diaphragm
 - subtle, have pt lean forward, breathe out
 - associated with wide pulse pressure



Aortic regurgitation findings

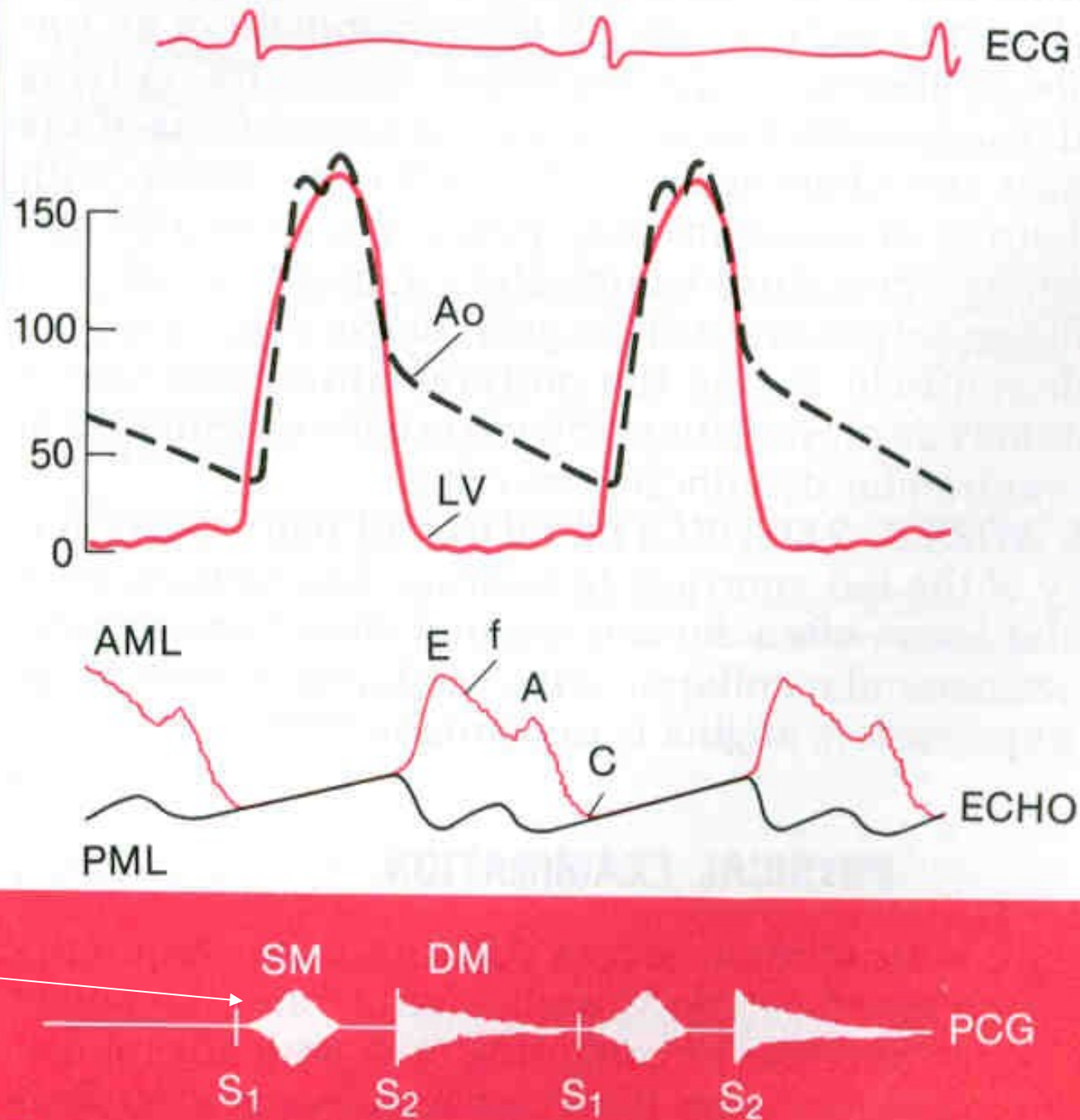
- S3
- Soft S1 and A2
- Blowing decrescendo diastolic murmur
 - Begins immediately with A2
 - High frequency (diaphragm)
 - Press firmly & concentrate
 - Inconsistent relationship between duration and severity
- Associated murmurs
 - Often has systolic ejection flow murmur
 - Austin-Flint murmur at apex sounds like mitral stenosis





Chronic AR

Early diastolic
decrecendo
murmur at
time of
greatest
pressure
difference
between Ao
and LV. Note
early diastolic



AR easily missed





Additional findings

- Wide pulse pressure with low diastolic
 - “Water hammer pulses”
- Durosiez’s sign
 - To and fro bruit at femoral artery
- Hill’s sign
 - Popliteal arterial pressure > 20 mm Hg more than brachial
- Quinke’s sign
 - Nailbeds flush with systole
- de Musset's sign (Head nodding in time with the heart beat)



AR Signs of Severity

- Diastolic blood pressure less than 50
- Enlarged LV
- S3
- Signs of congestive heart failure



Case 1

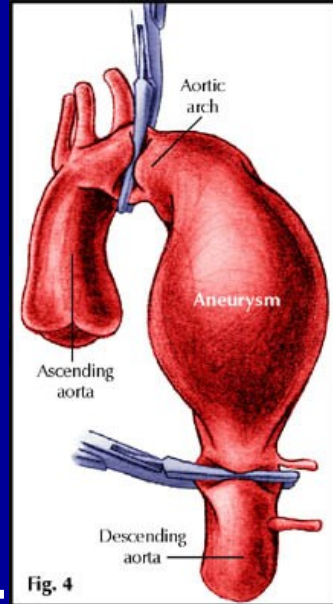
- **First case**
- **18 yo airman Recruit**
- **Varsity Basketball in HS**
- **No symptoms; here for accession physical**





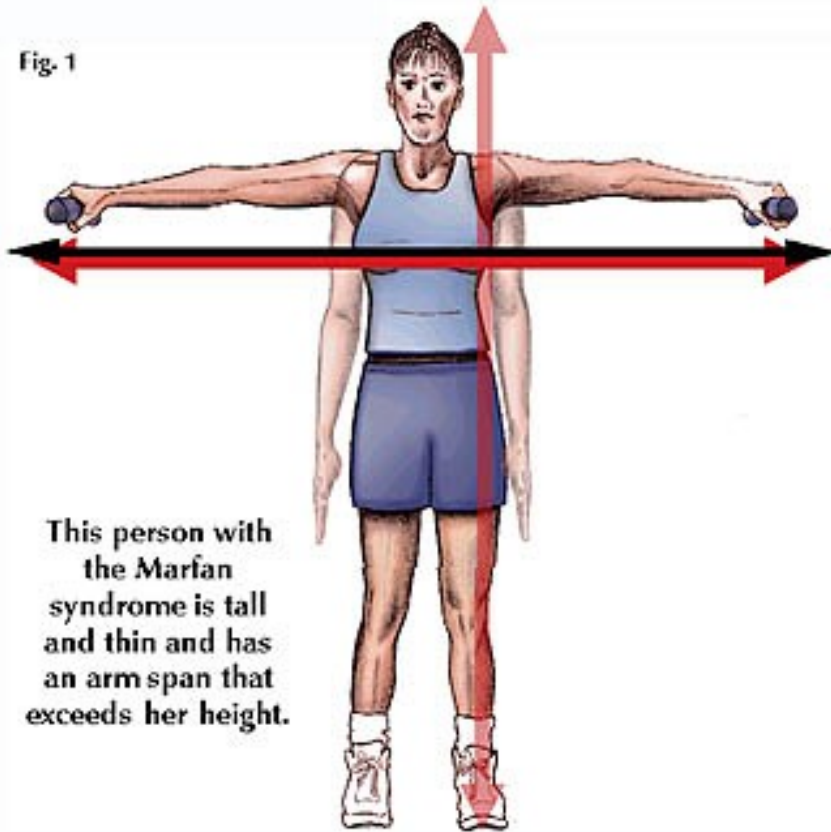
Marfan Syndrome

- Inherited disorder of collagen
- Associated with tall stature, wide “wing span,” ocular lens dislocation, hypermobile joints
- Cystic medial necrosis of the aorta
 - Aortic aneurysm and dissection
- Aortic regurgitation due to root dilatation
- Mitral valve prolapse



Marfan Syndrome

Fig. 1



Case 2

- **51 year old man**
- **Rheumatic fever at 12**
- **Heart rhythm disorder found after transient loss of speech 6 mos ago**
- **Recently tired and short of breath**





Mitral stenosis



Atrial
appendag
e



Case 3

- **40 year old male**
- **Murmur detected on and off for many years**
- **Notes that he is not able to exert himself like formerly; attributes it to getting old**





Atrial Septal Defect

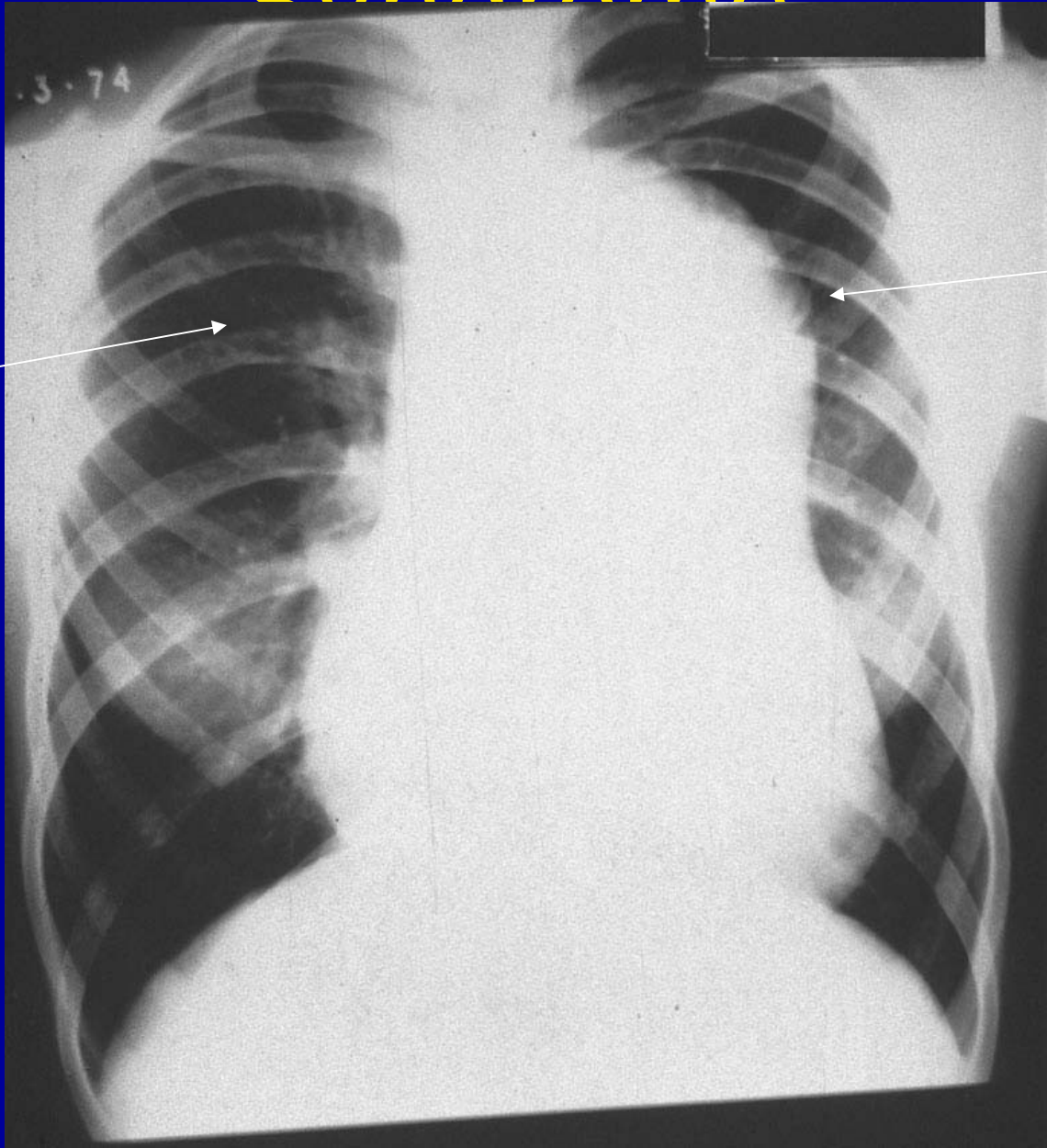
- Often asymptomatic into middle age
 - Insidious progression to Eisenmenger's syndrome if not picked up
- Typically see significant improvement in exercise tolerance post-correction
- Many can be closed percutaneously
- Fixed split S2 and midsystolic flow murmur early; loud P2 later as pulmonary pressures increase



ASD, Eisenmenger Syndrome

Oligemia

PA Aneurysm



Case 4

- **22 year old male**
- **Murmur noted at age 9**
- **Fainted during touch football game**





Syncope and murmur

- AS, HOCM, MS, pulmonic stenosis associated with cardiovascular syncope
 - Mechanical obstruction of cardiac output
 - Can lead to extreme intracardiac pressures and/or ischemia
 - Before Ao valve surgery, 75% of AS patients died suddenly



Case 5

- **63 year old woman**
- **Enlarged heart for two years**
- **Notes increasing difficulty carrying groceries over 6 months**
- **Episodes of irregular heart action over past two months**





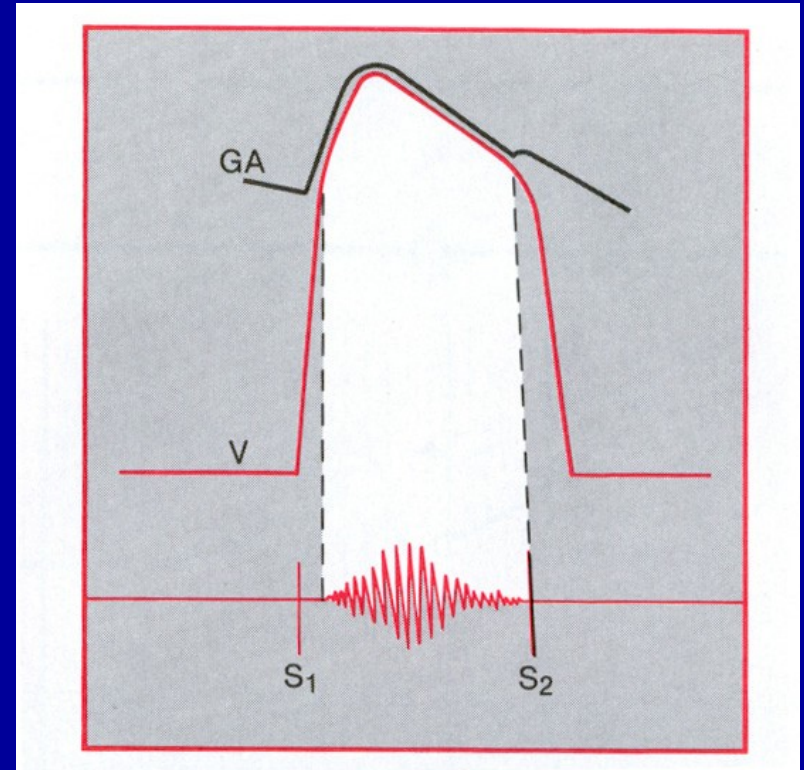
Mitral Regurgitation

- No proven medical therapy to prevent progression
- Chronic volume overload causes atrial dilatation, fibrillation
 - Less prone to stroke than MS; ?MR jet scrubs the left atrium
- Chronic volume overload causes ventricular dilatation, failure
 - Need to operate when EF <60%



Mid-systolic Murmurs

- Mid-systole is the EJECTION PERIOD
 - MSM are therefore “Ejection Murmurs”
- Ejection starts after S1, peaks soon after, and diminishes before S2
 - Ejection murmurs MUST be crescendo-decrescendo
 - Holosystolic murmurs are NOT ejection murmurs

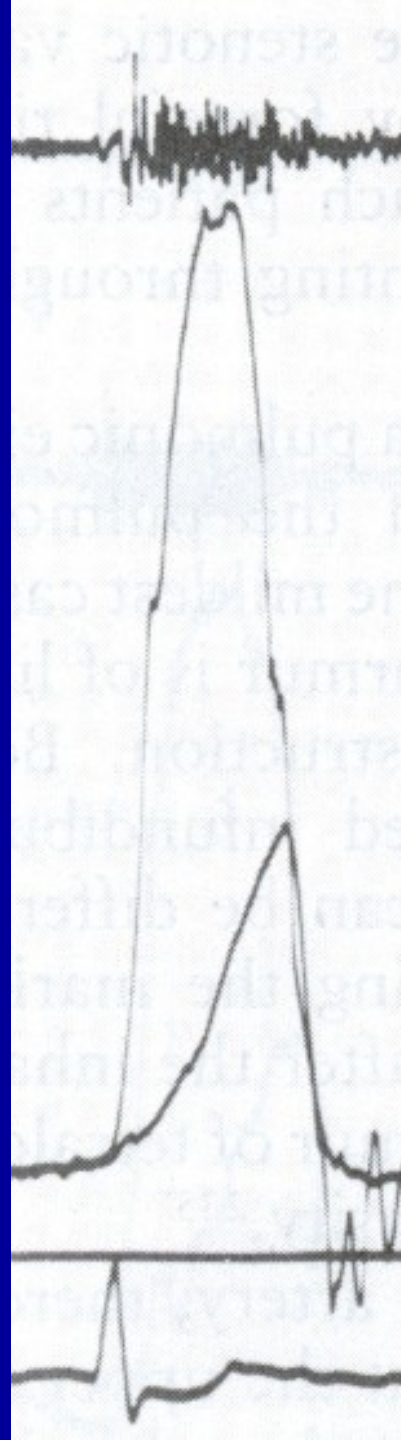


Why do MSM sometimes sound Holosystolic?

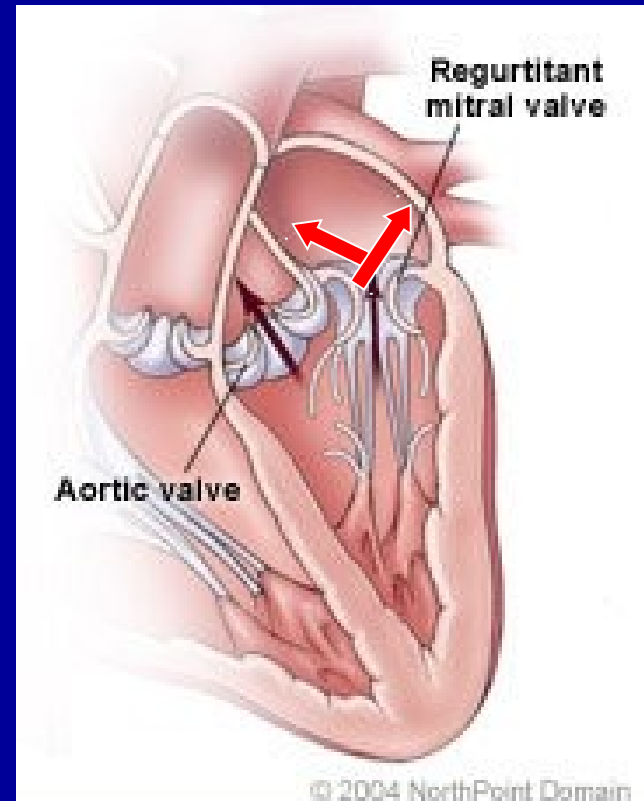
- Very loud MSMs (i.e. aortic stenosis) may sound holosystolic because they blow your ears off
 - Ability to discern modulation is saturated
 - Witness effect
- Experienced auscultators hear the right things because they know what to expect
 - “Chance observation favors the prepared mind.”
 - If one is expecting aortic stenosis, one will hear aortic stenosis



- Mitral regurgitation due to dilatation or rheumatic disease tends to give a concentric jet
- MR due to prolapse tends to be eccentric and may be heard in odd locations

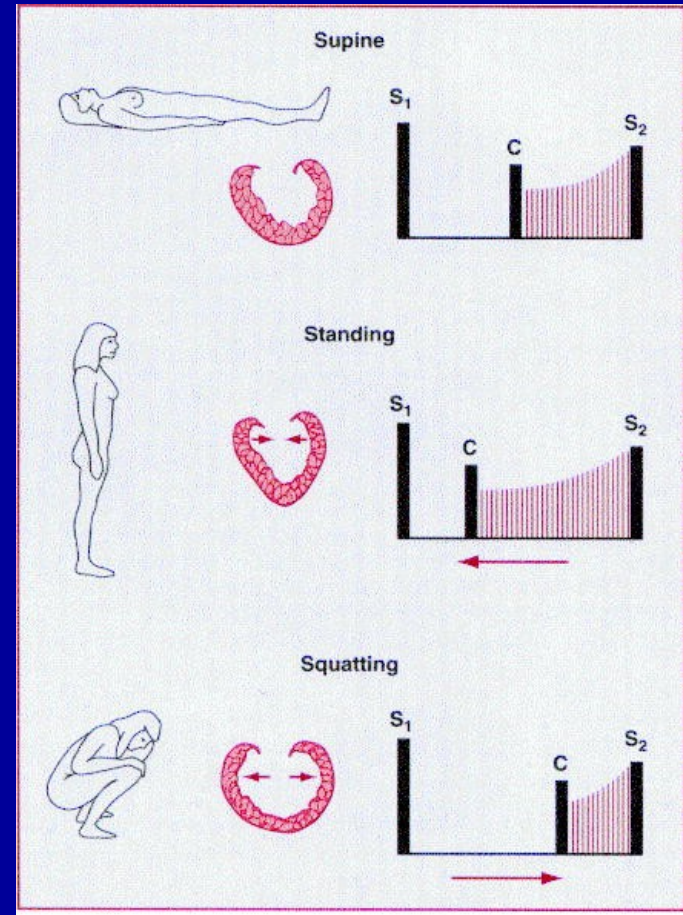
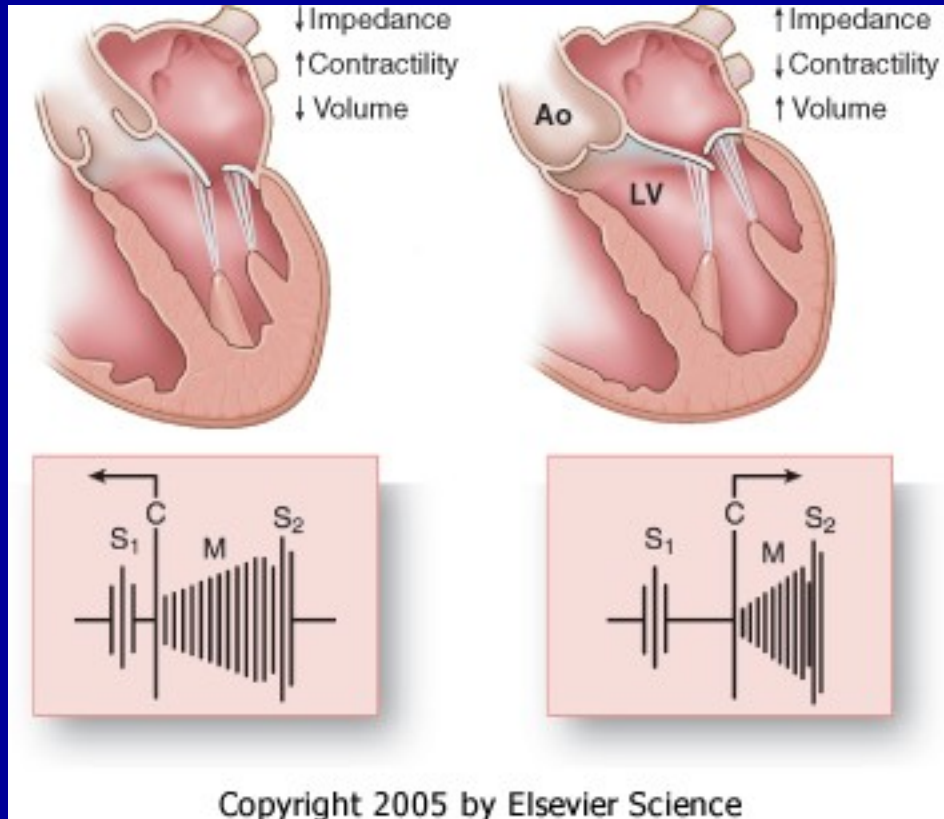


Eccentric jet

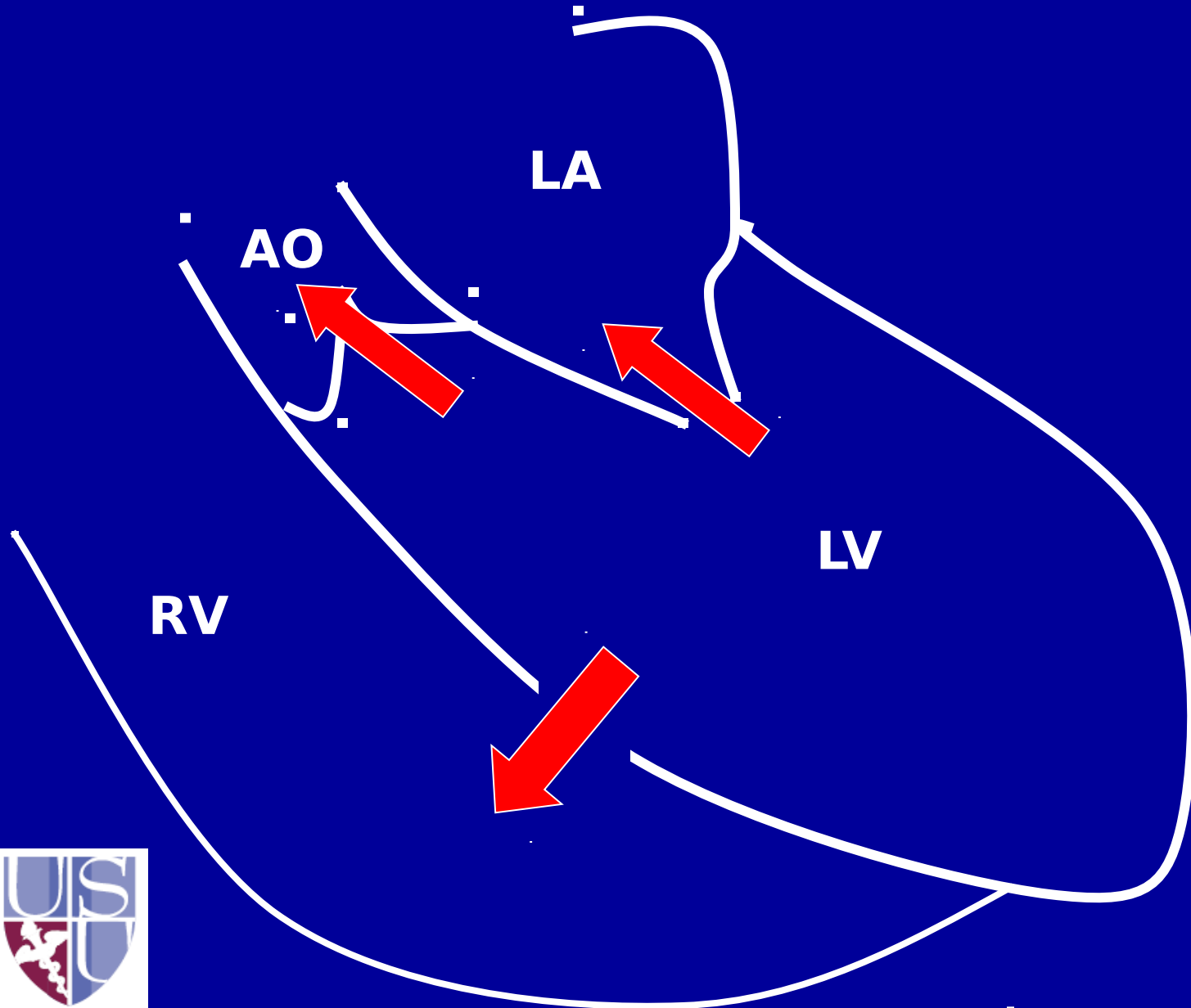


As the heart pumps and the aortic valve opens to allow blood into the aorta, a regurgitant mitral valve allows blood to leak backward into the left atrium.

MVP: a dynamic murmur



Systole



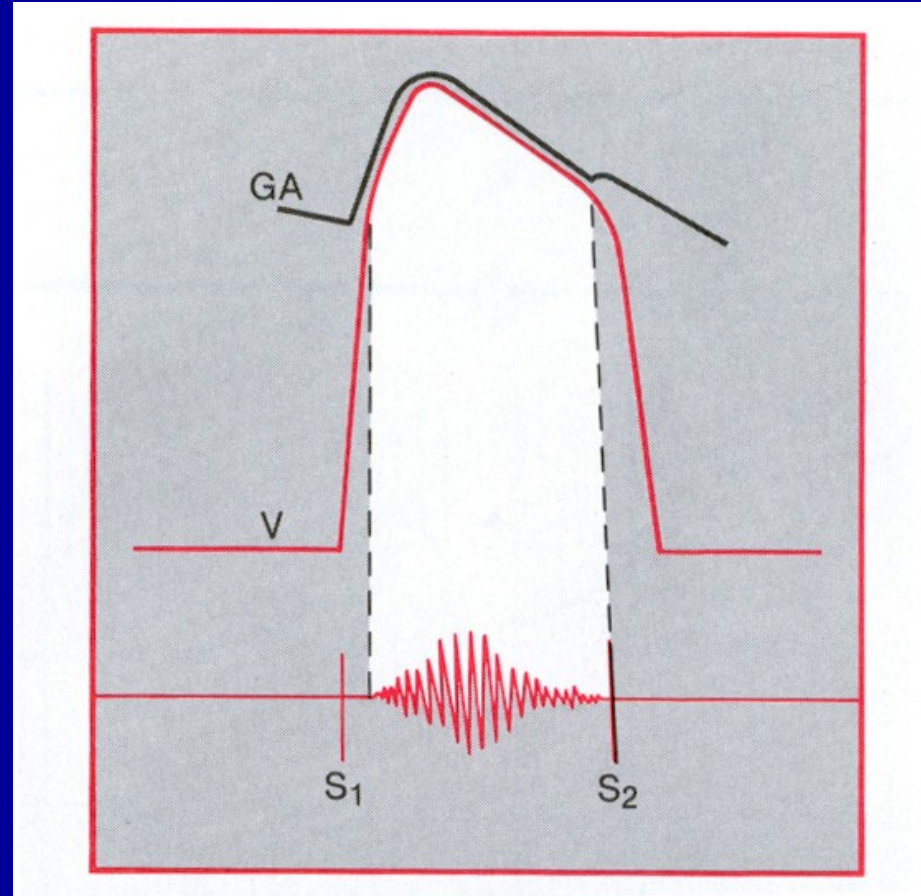
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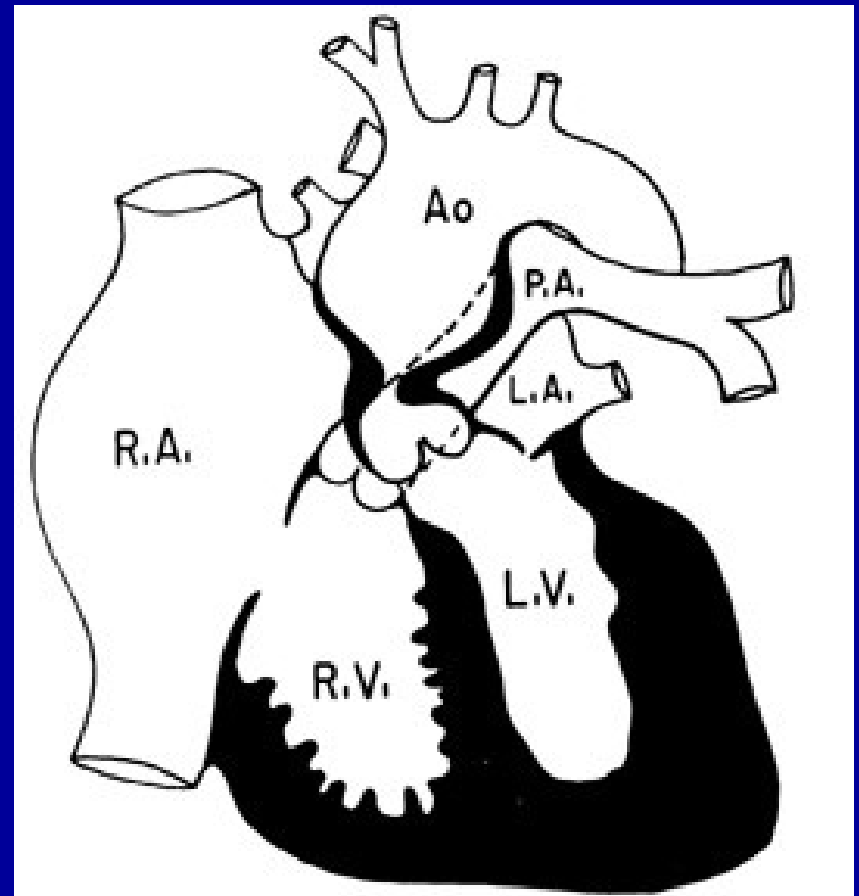
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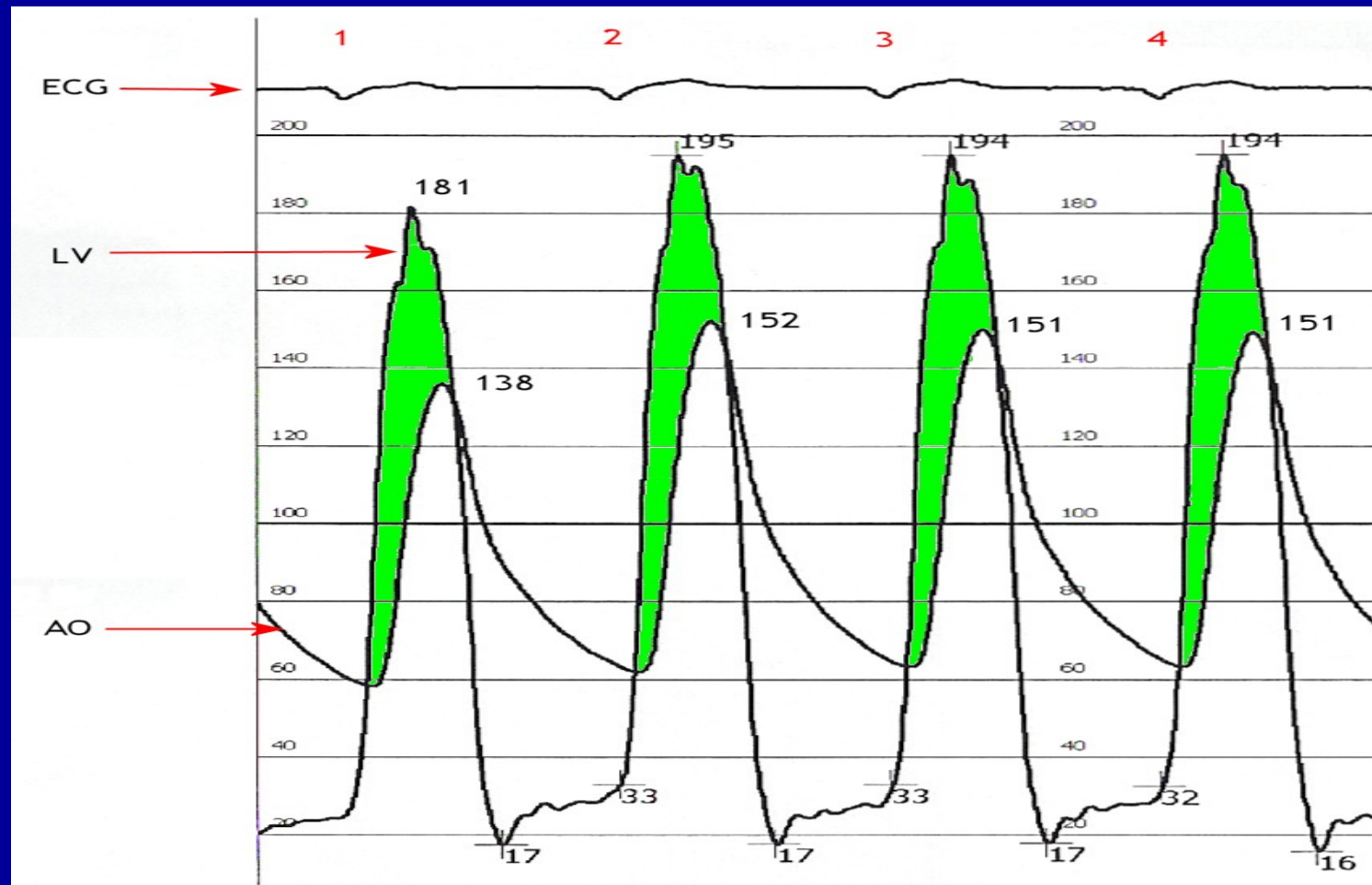
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Valvular Aortic Stenosis

